FIG. 1

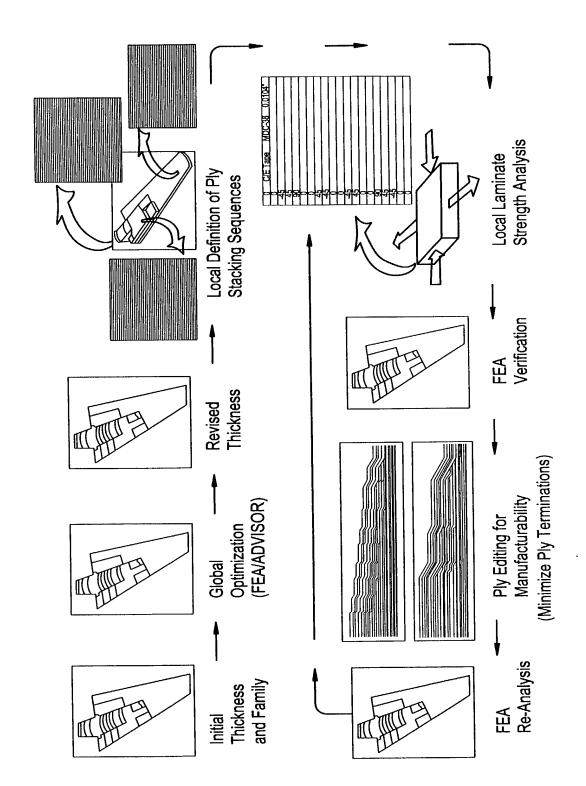
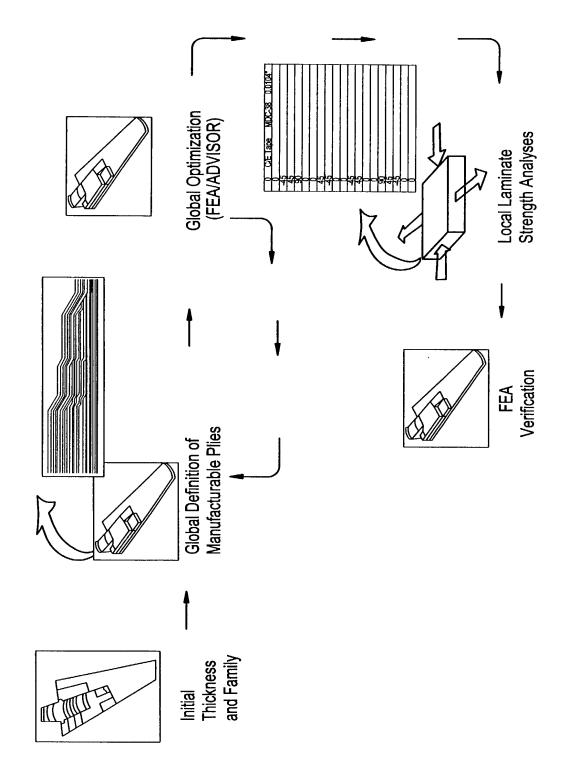


FIG. 2



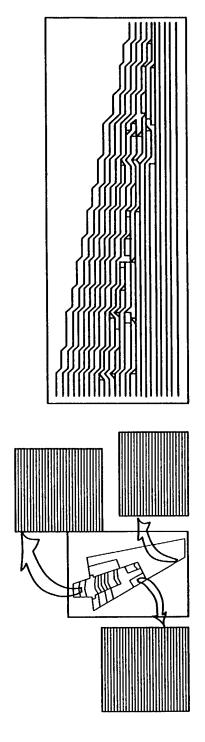
. . . .

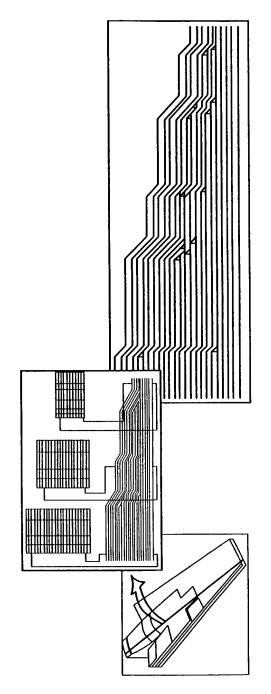
## FIG.3

13.23 41.2/47.1/11.8 11.59 47.1/47.1/5.9 12.56 44.4/44.4/11.1 12.19 42.1/42.1/15.8 11.78 47.4/42.1/10.5 12.74 52.6/42.1/5.3 13.61 50.0/40.0/10.0 13.23 42.9/38.1/19.0 11.90 47.6/38.1/14.3 12.80 45.5/36.4/18.2 12.38 54.5/36.4/9.1 14.07	5.46 4.39 7.10 6.12 6.86 4.97	2.89 0.52 2.79 0.42 2.69 0.30 2.69 0.35 2.61 0.30 2.61 0.42 2.53 0.30
_	5.74	2.53 0.35
56 5/34 8/8 7 14.44	4.83	2.53 0.41

11

FIG. 4





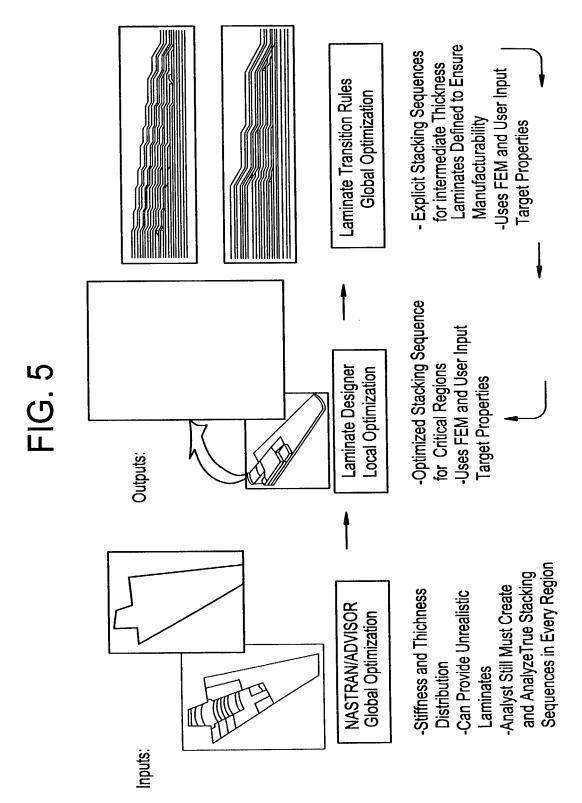
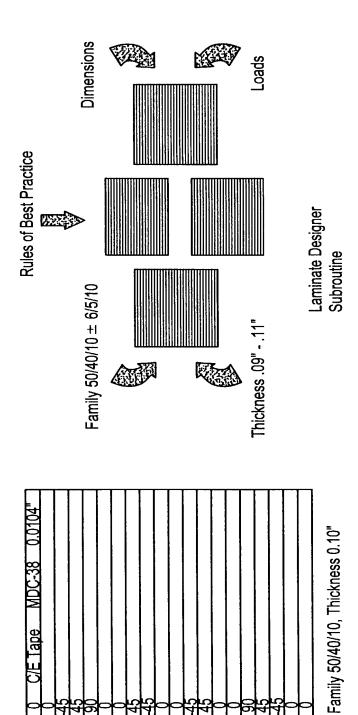
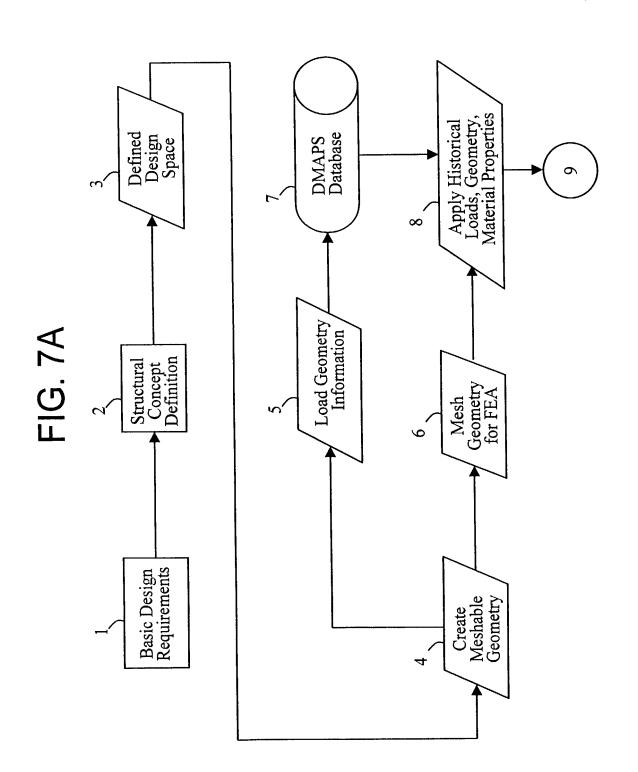


FIG. 6



Conventional Process



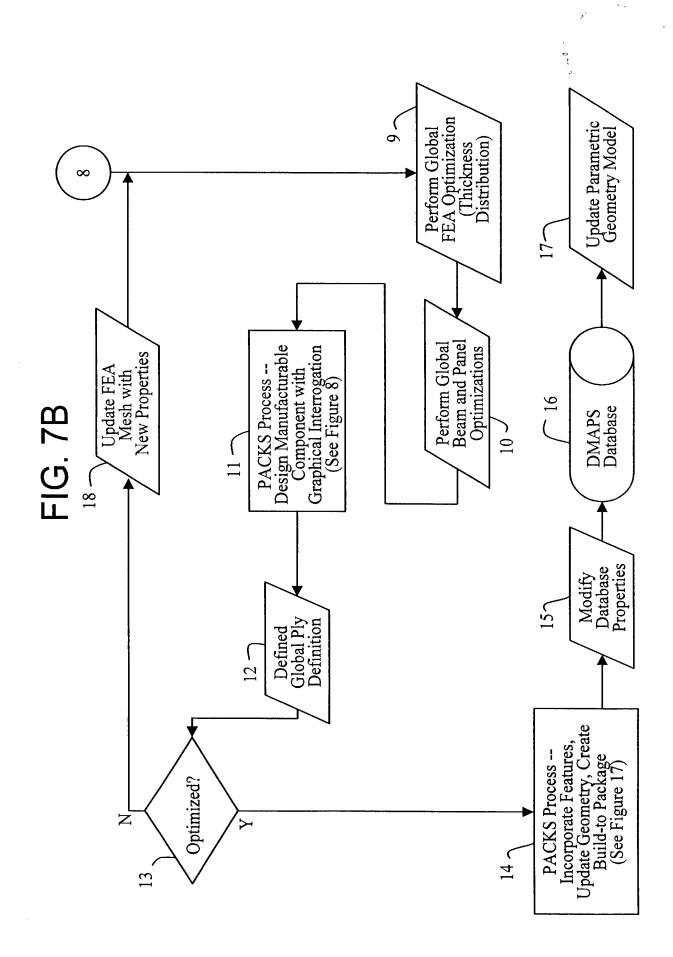
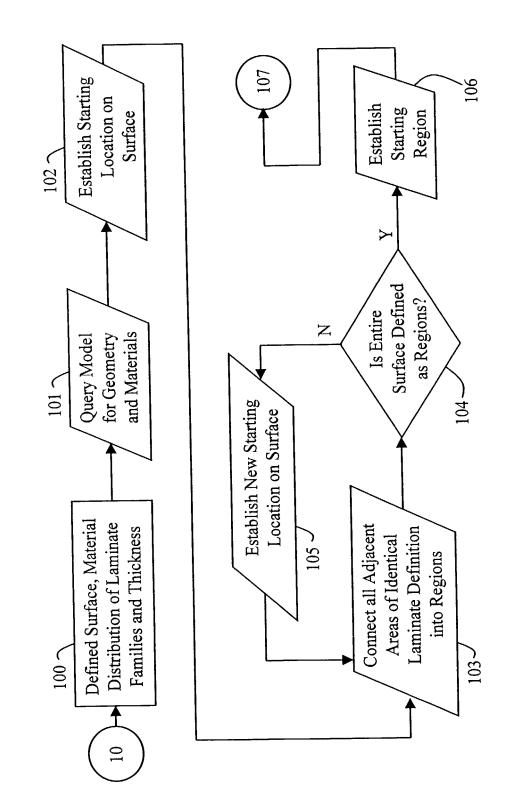
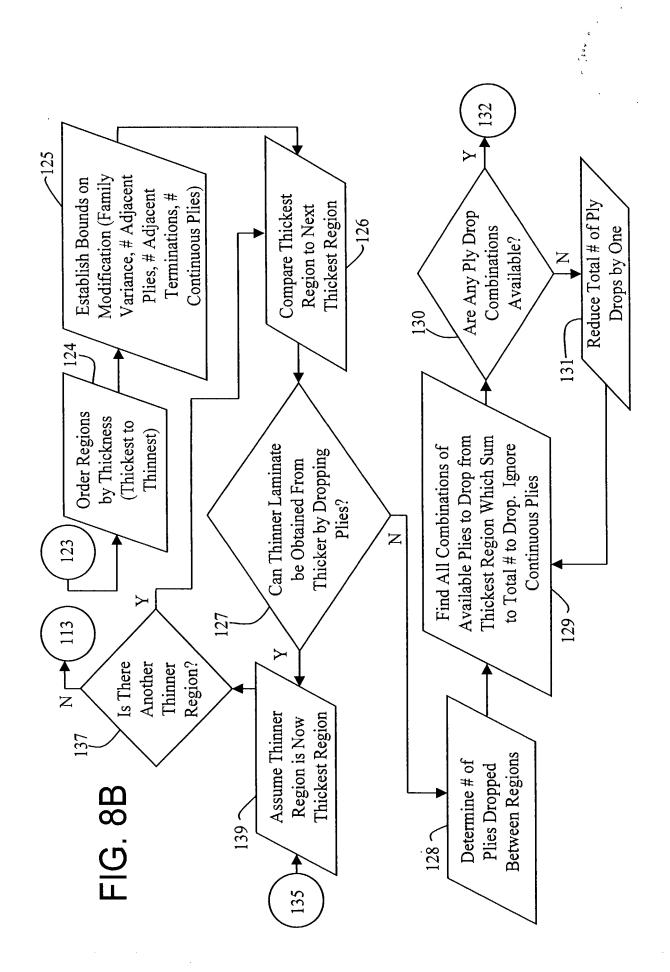
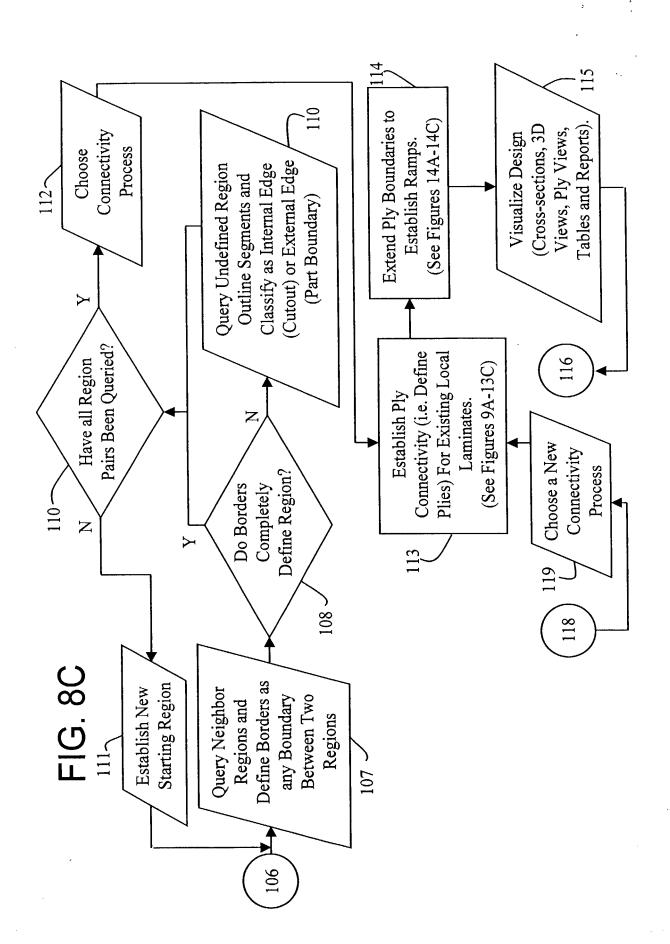
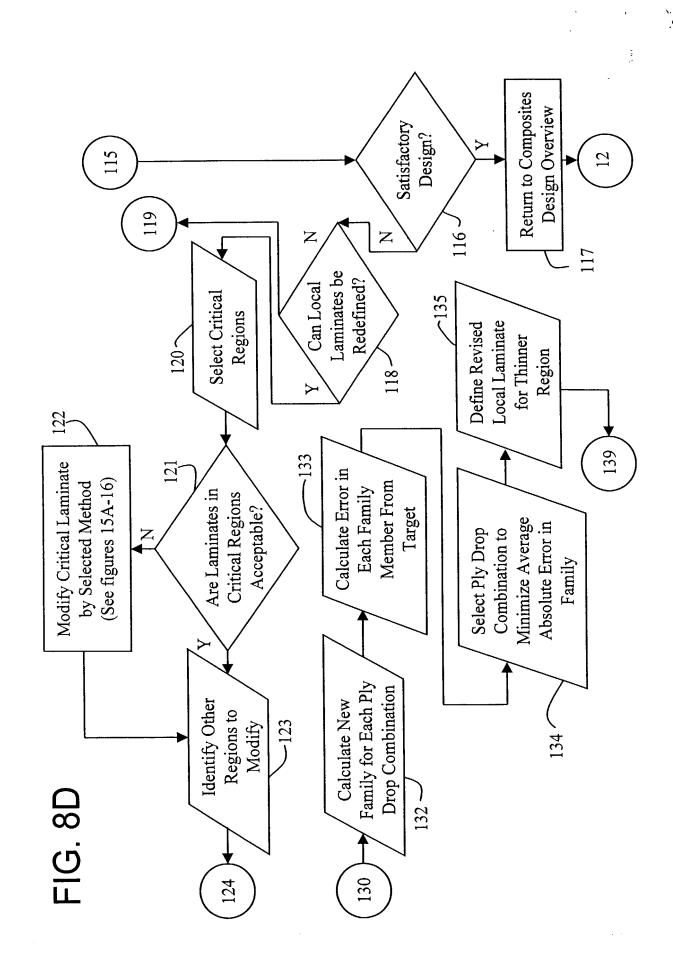


FIG. 8A

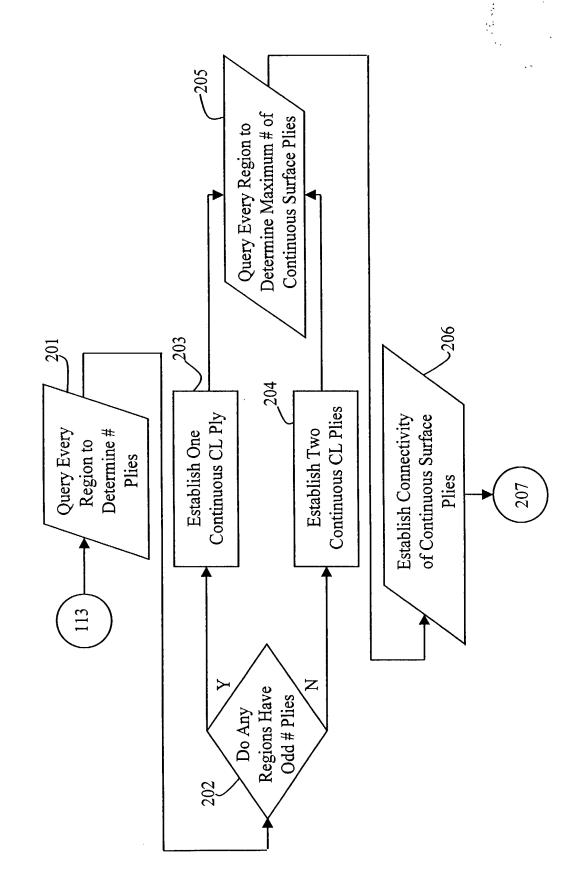


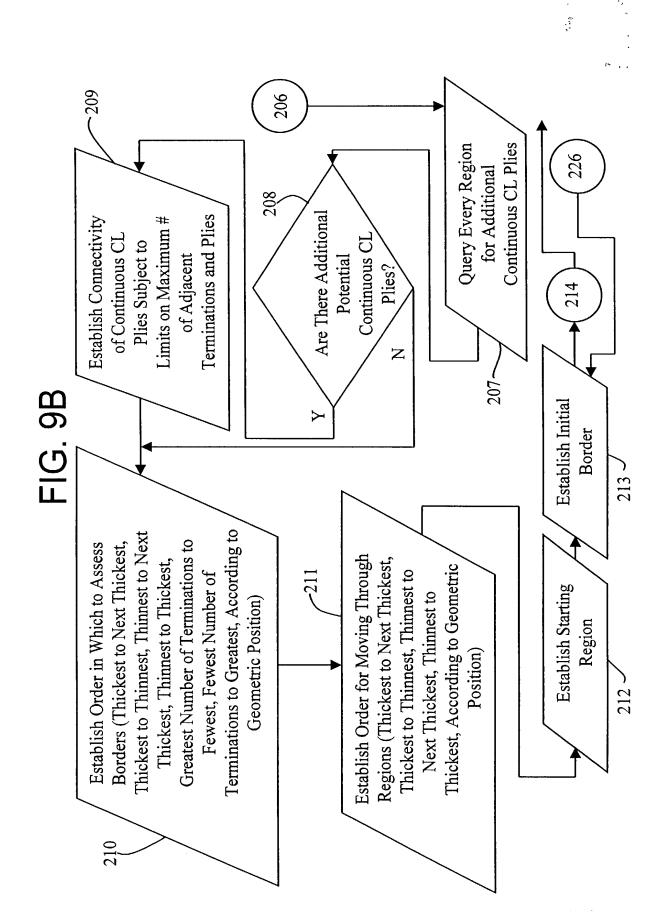


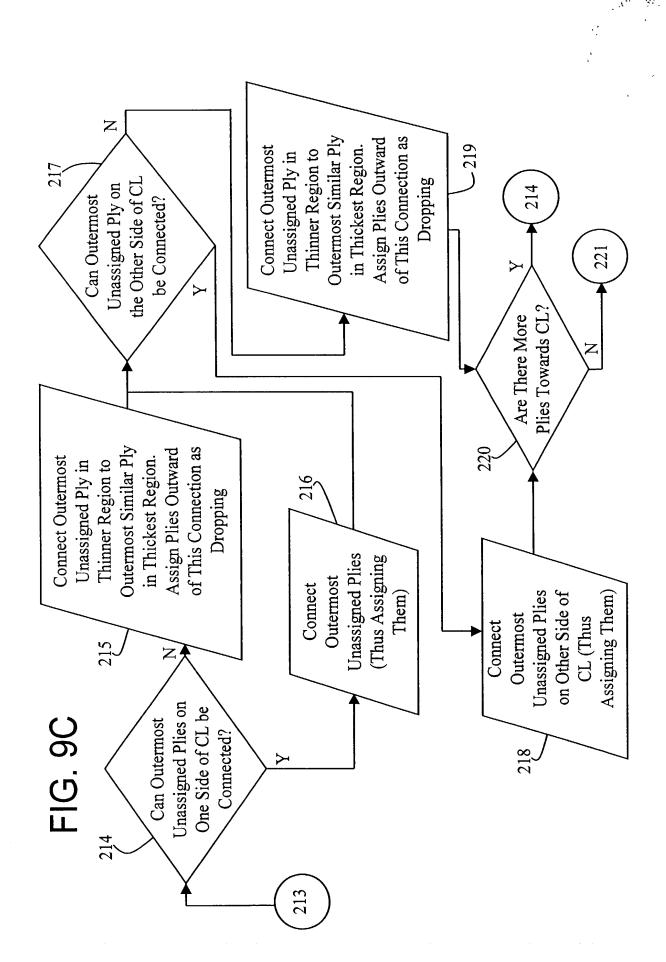


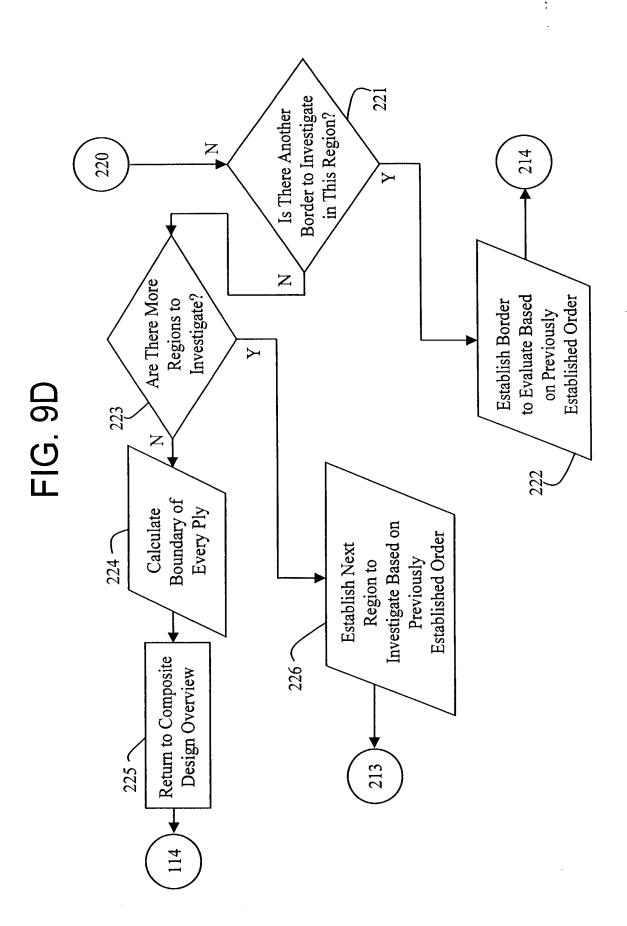


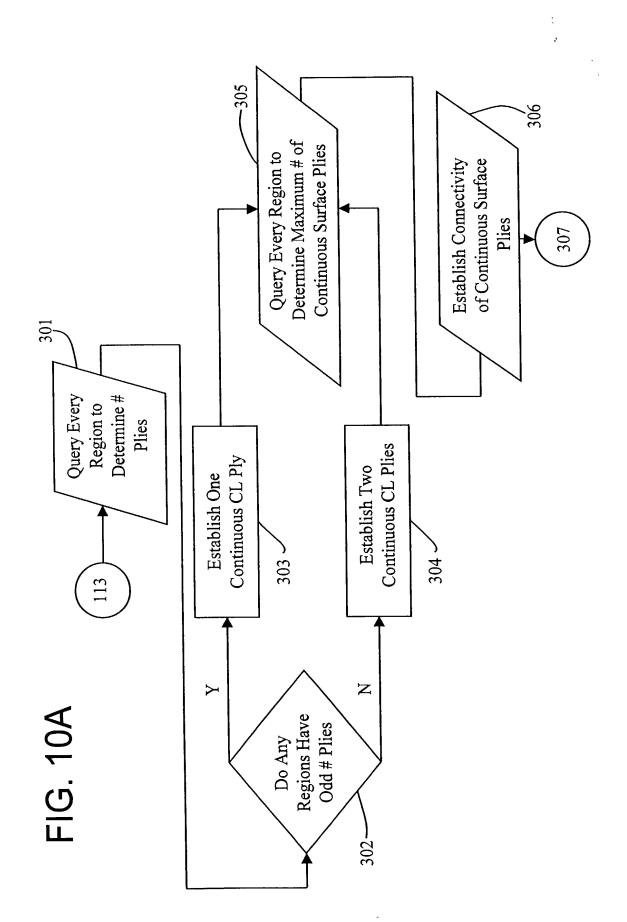


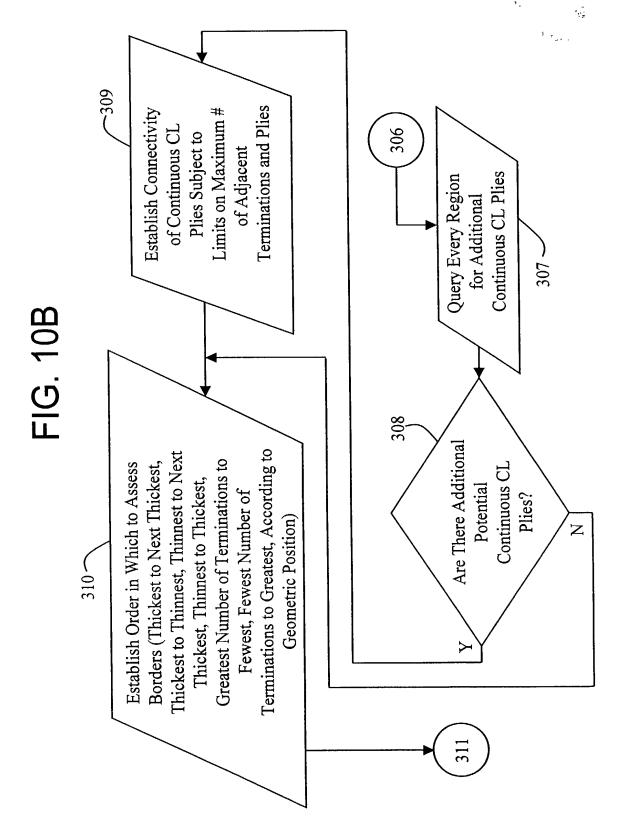


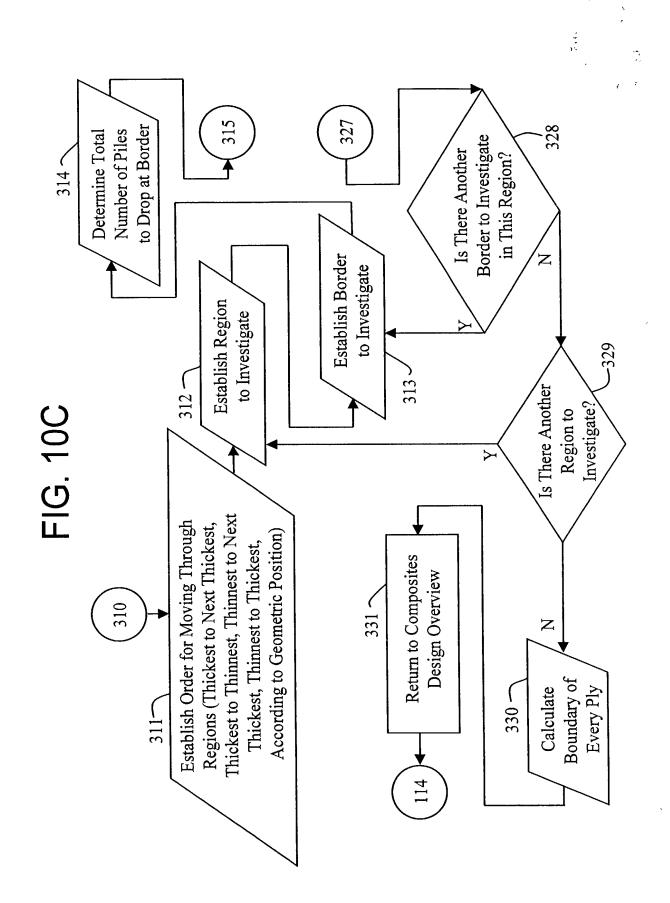


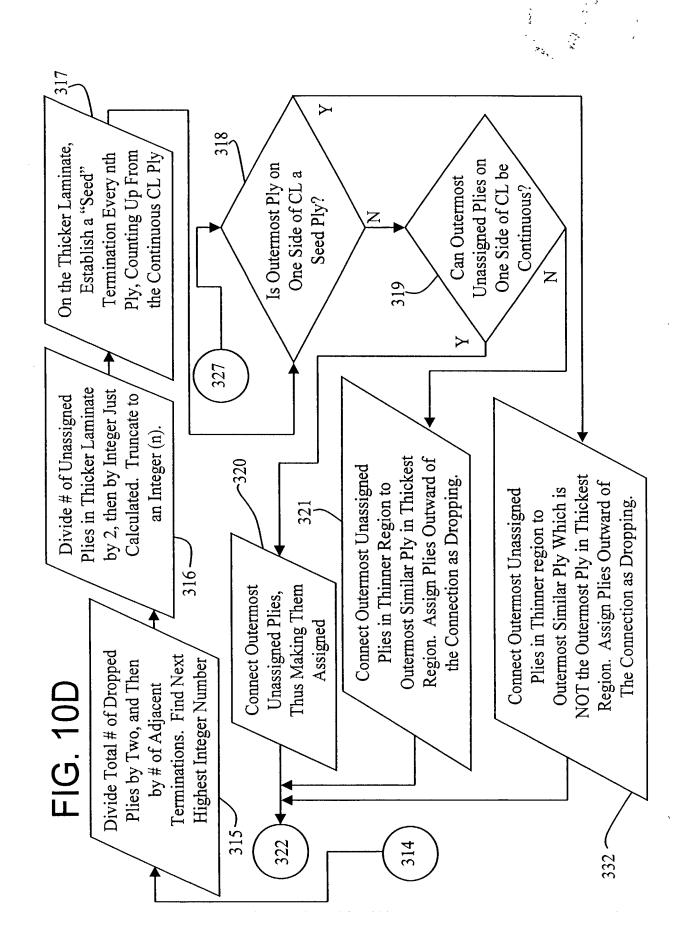


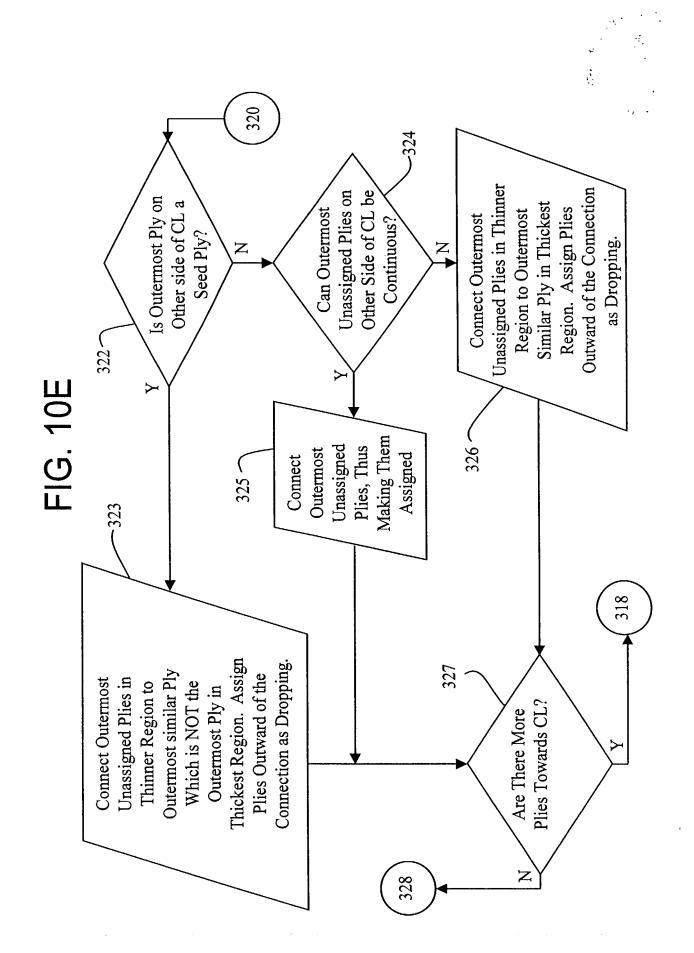


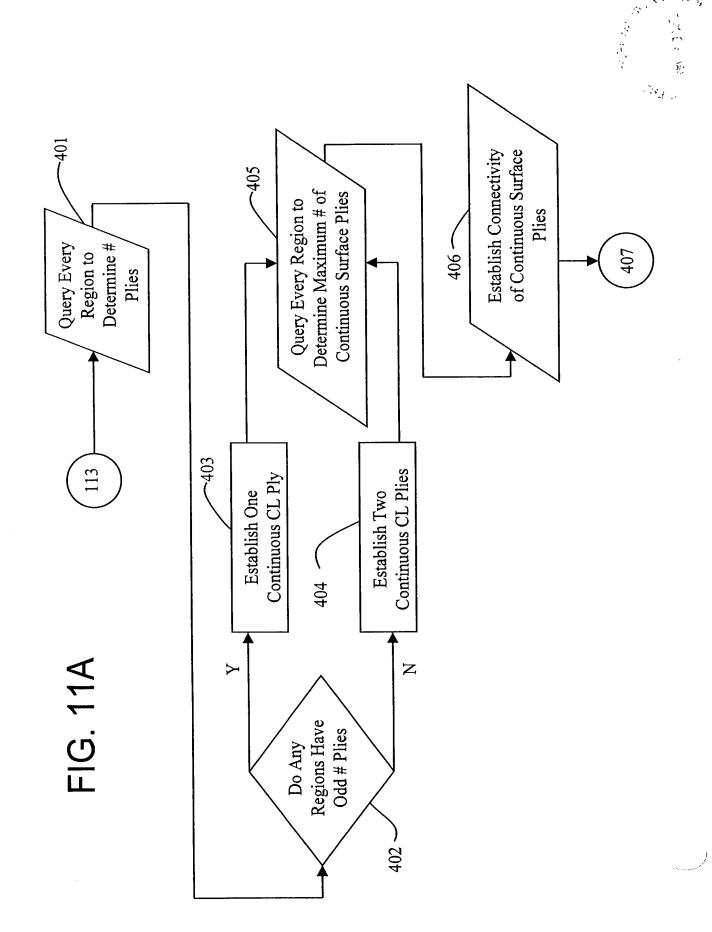


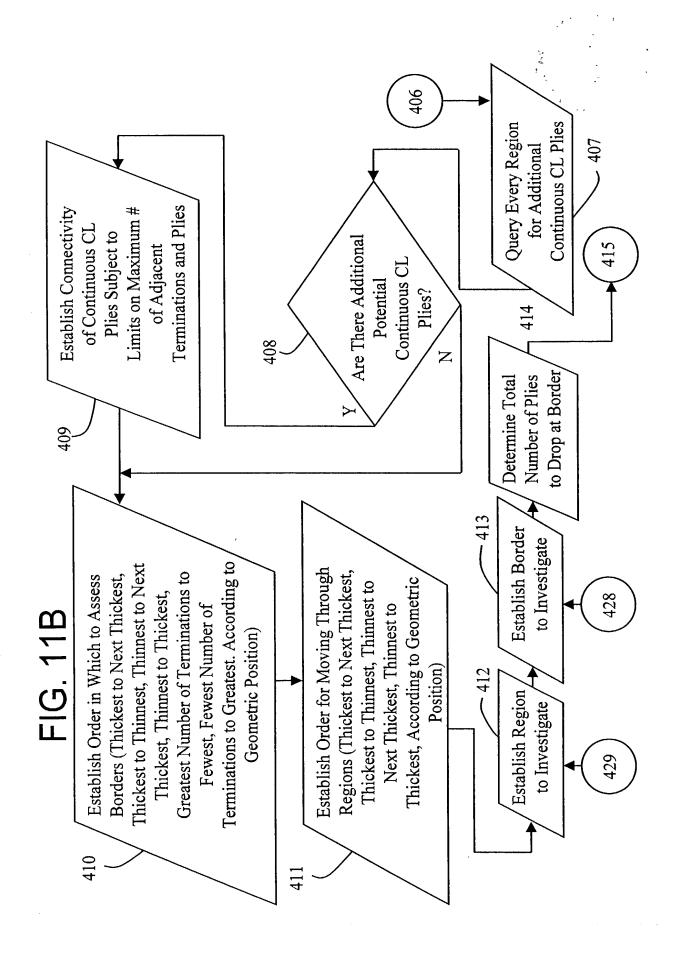


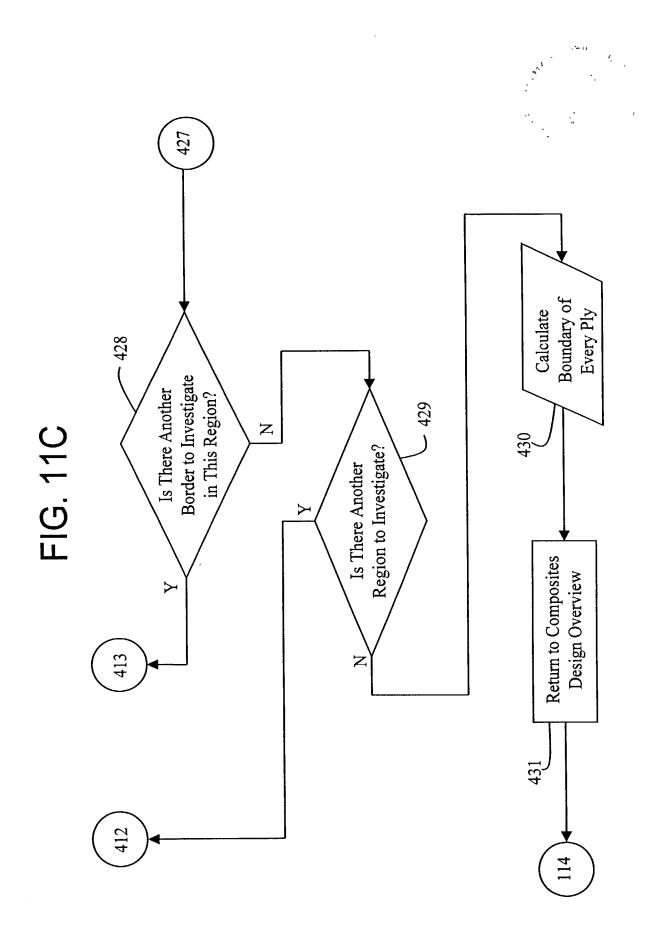




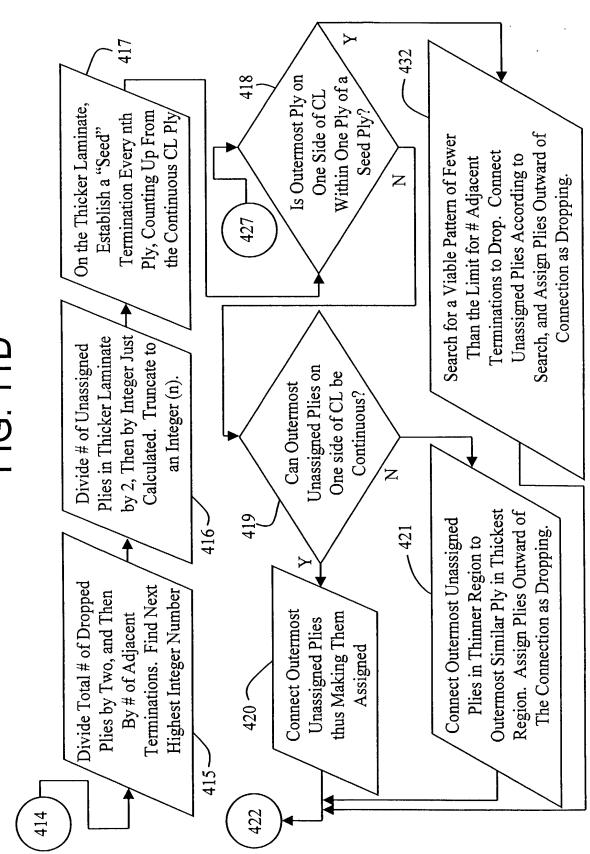


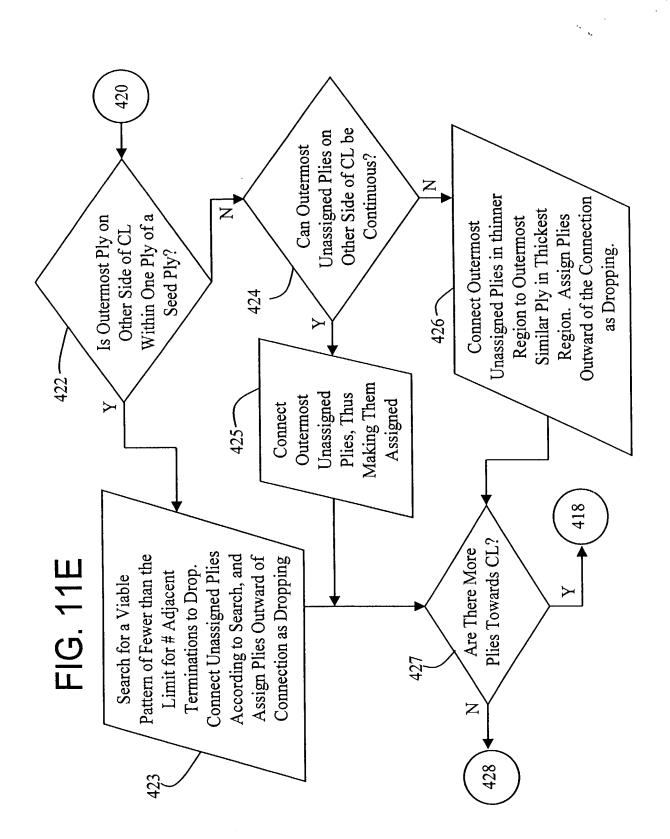


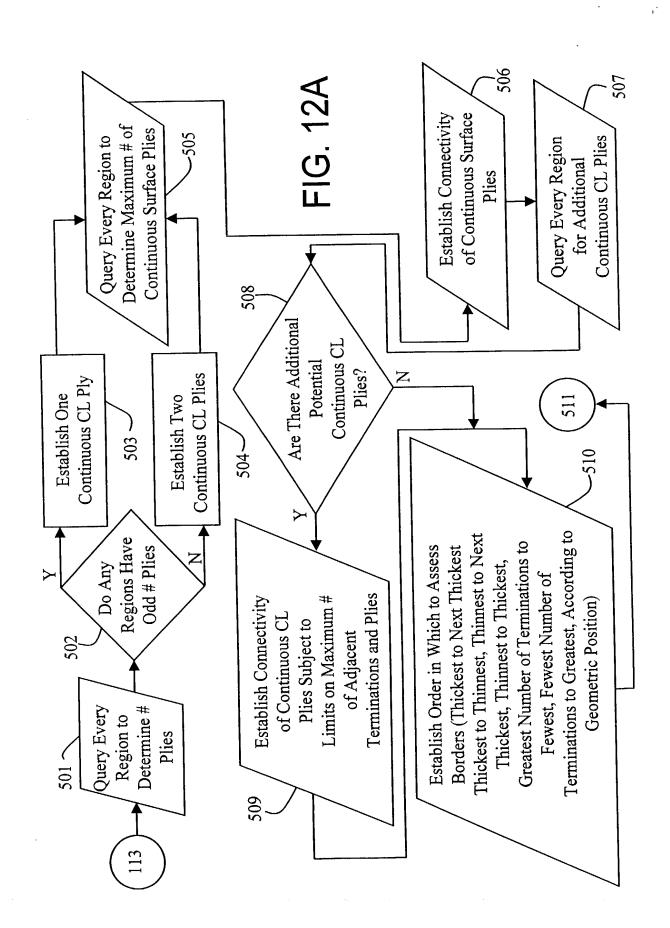


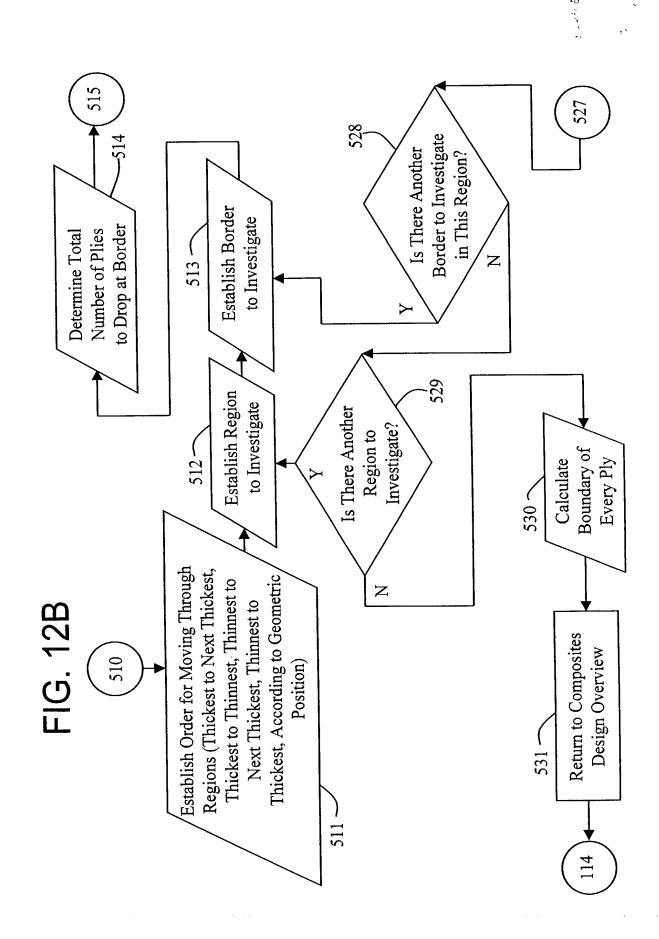


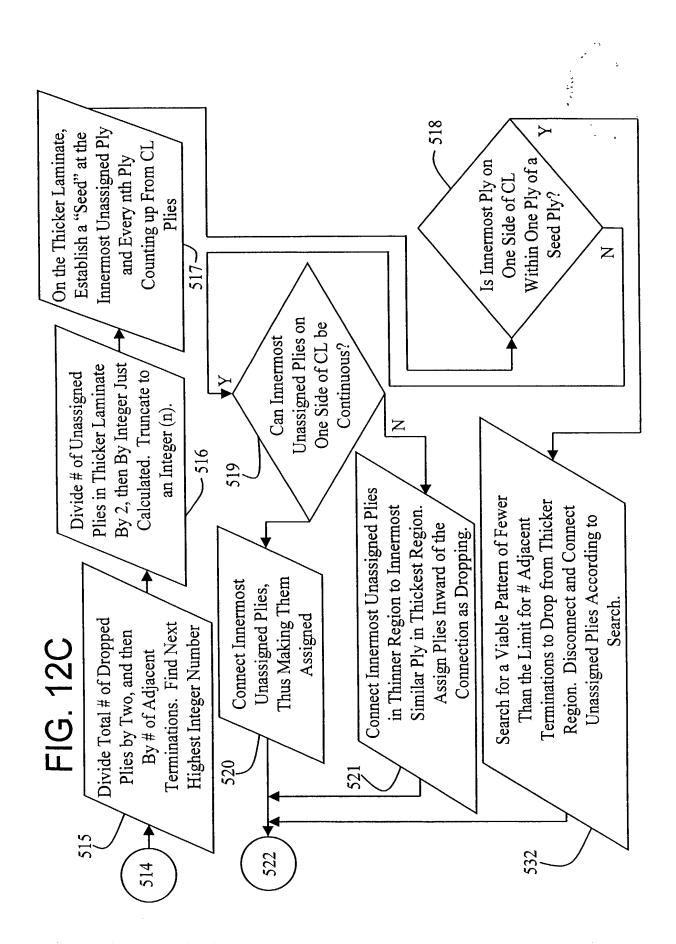
## FIG. 11D

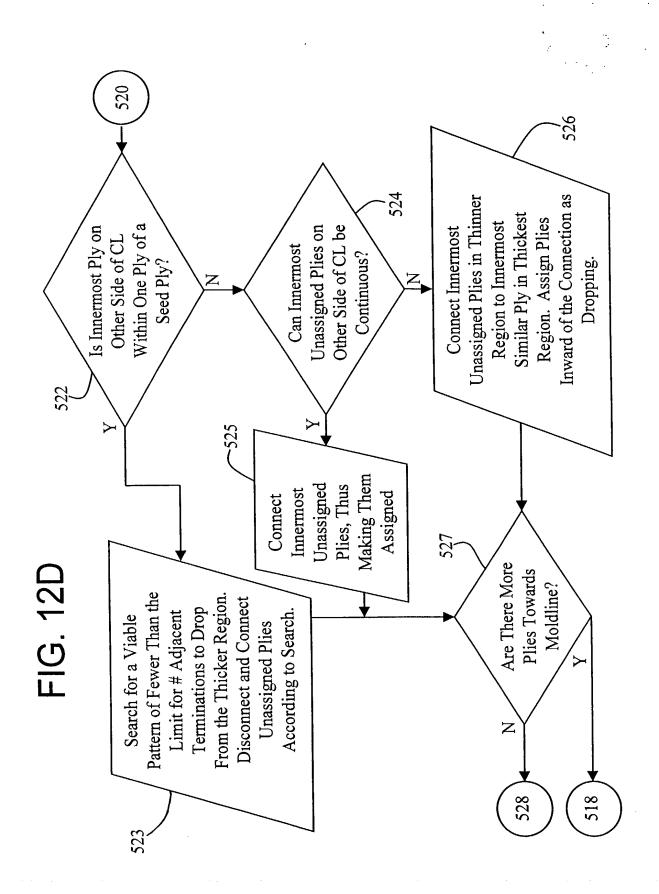


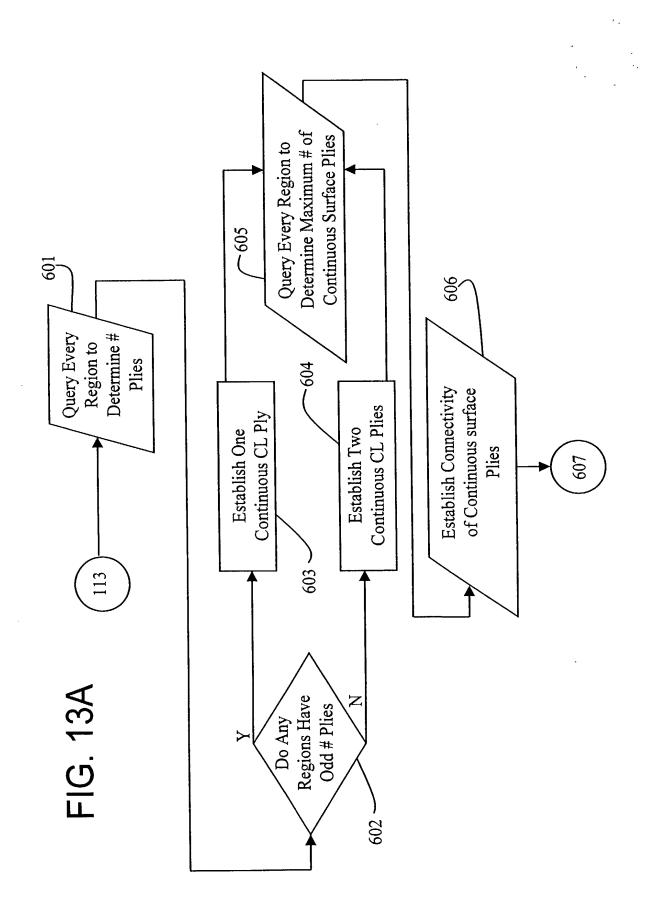


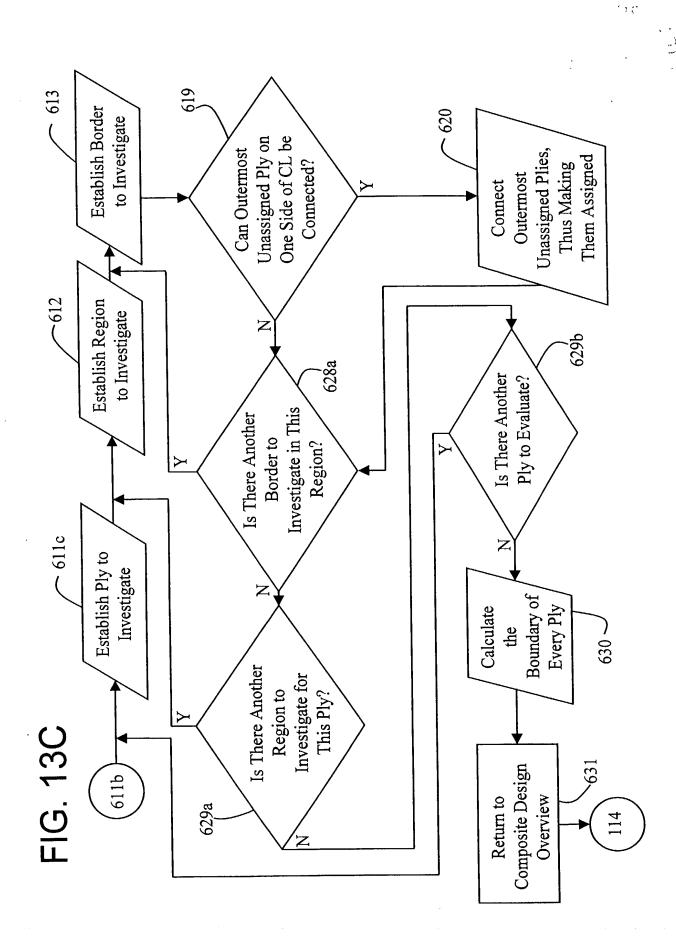


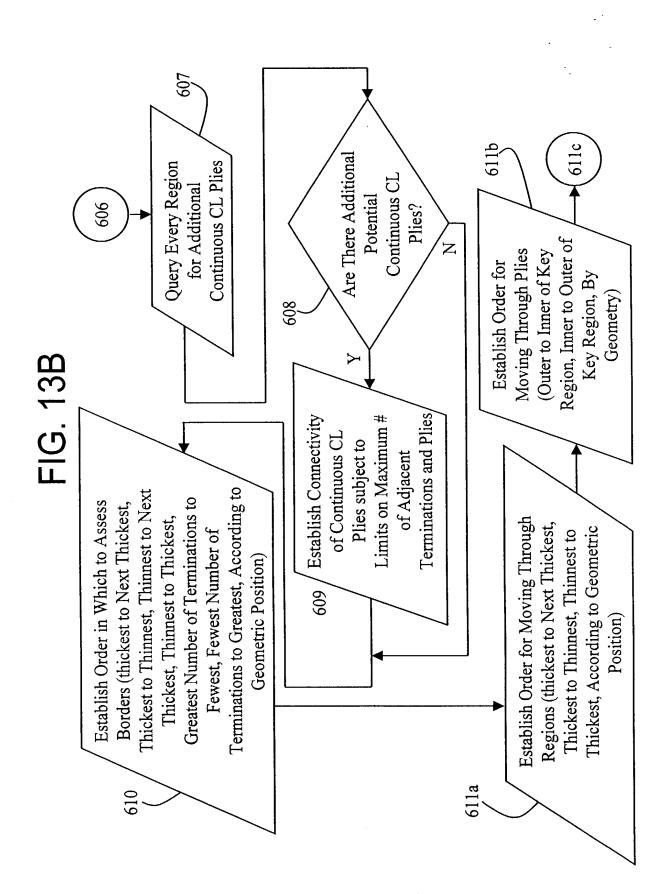


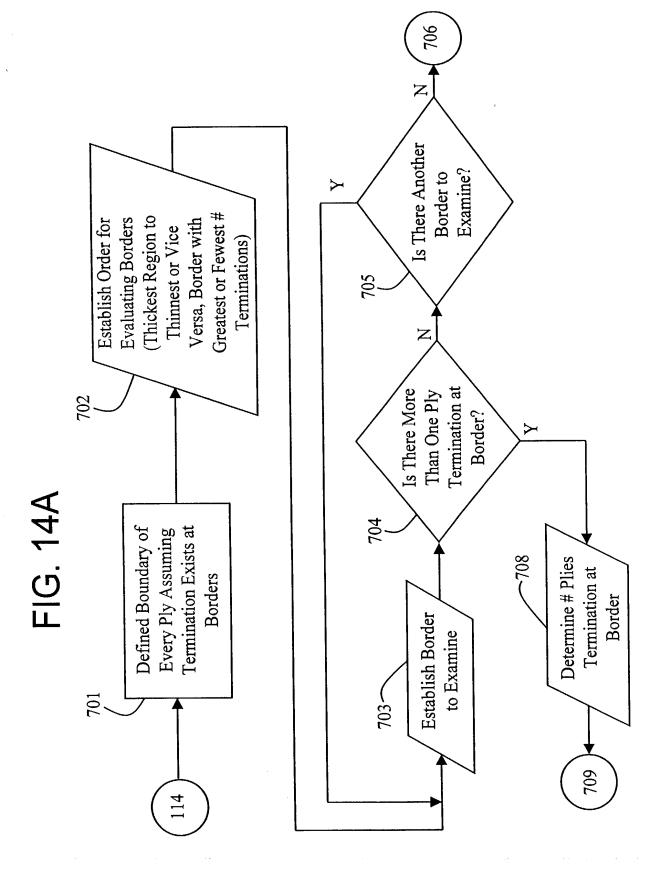


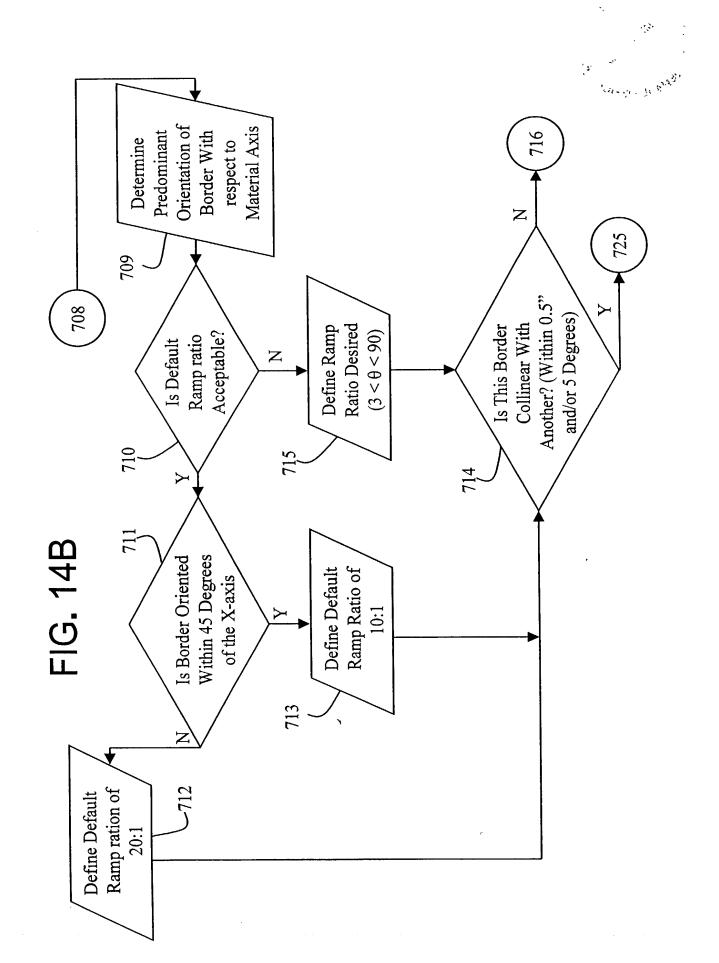


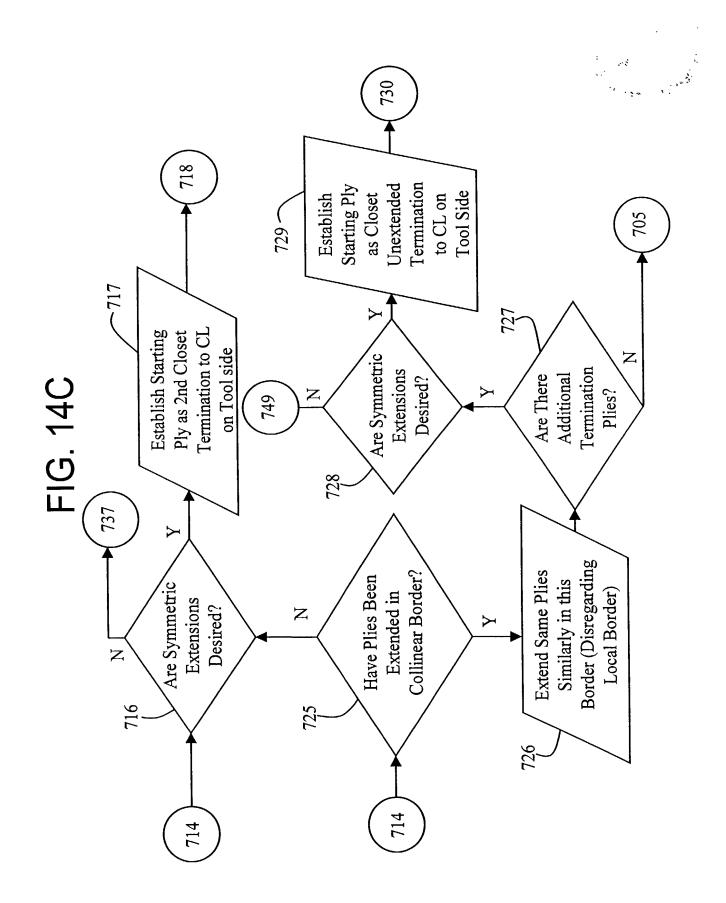


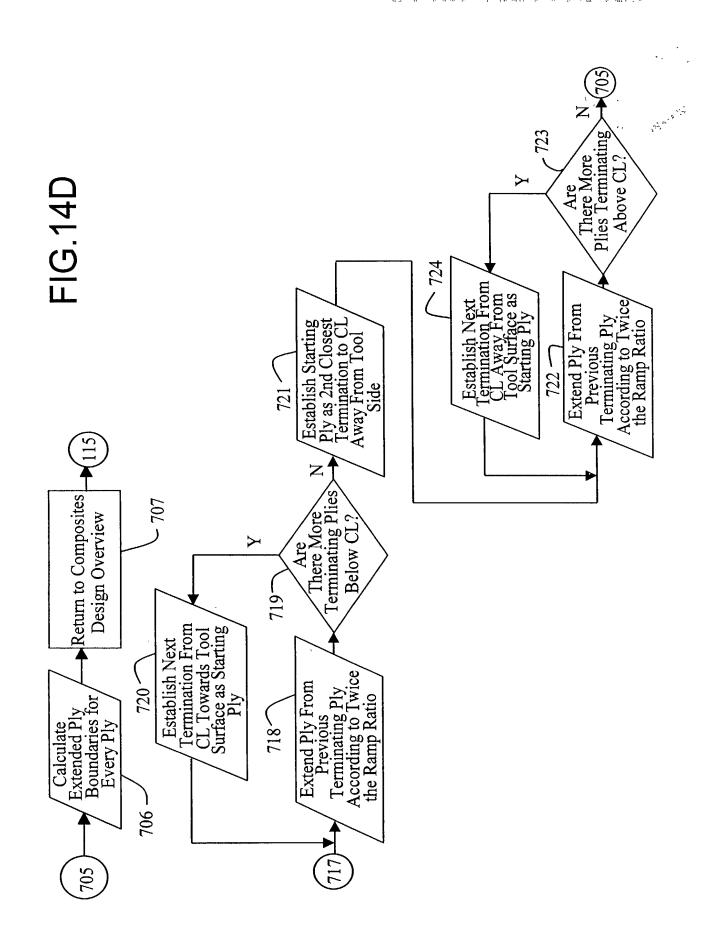


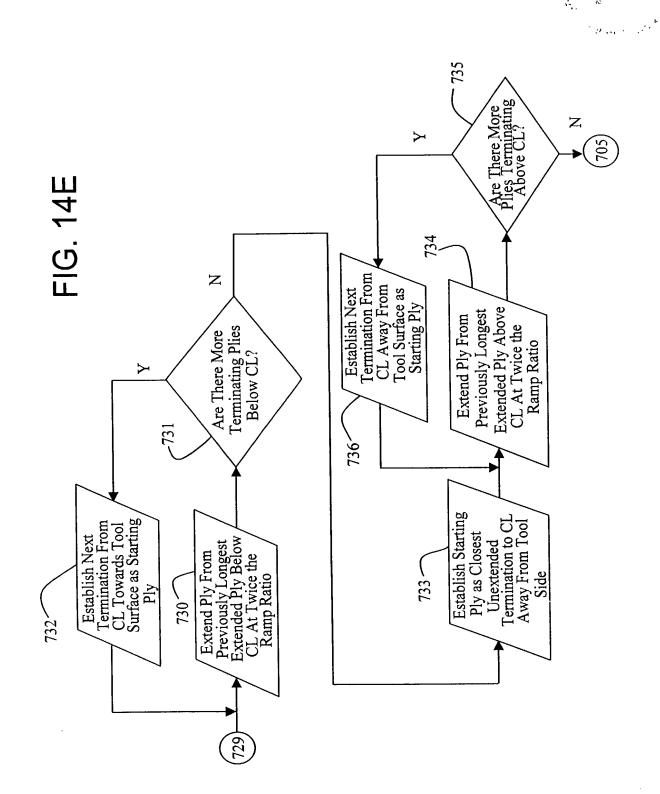


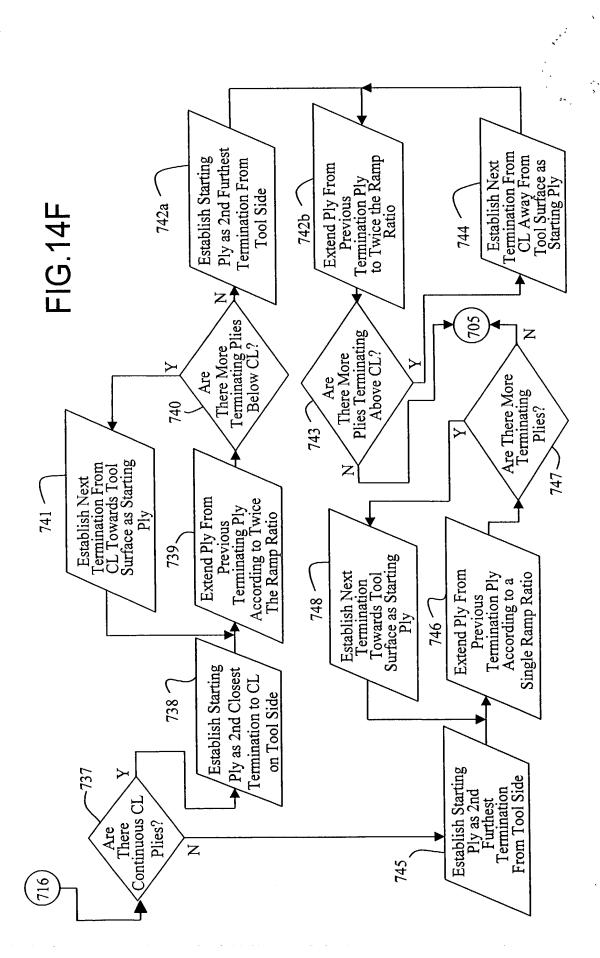


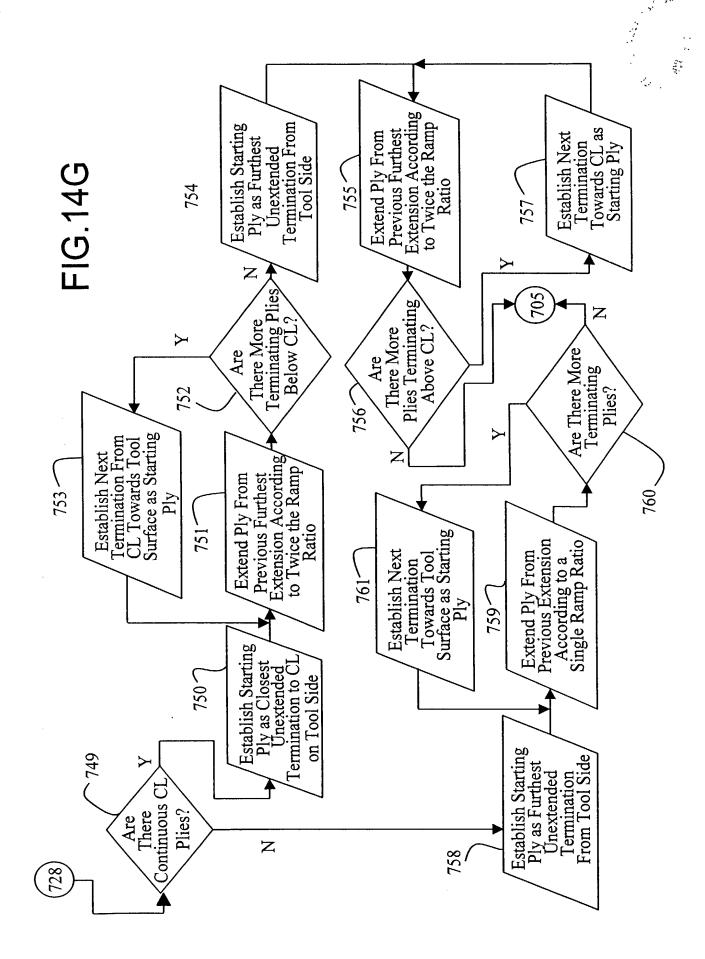








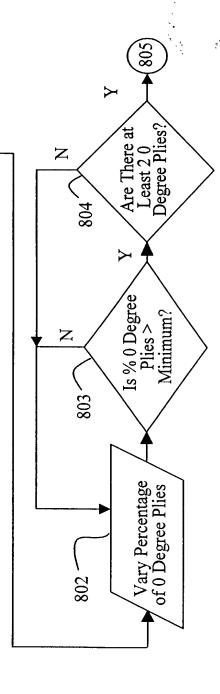


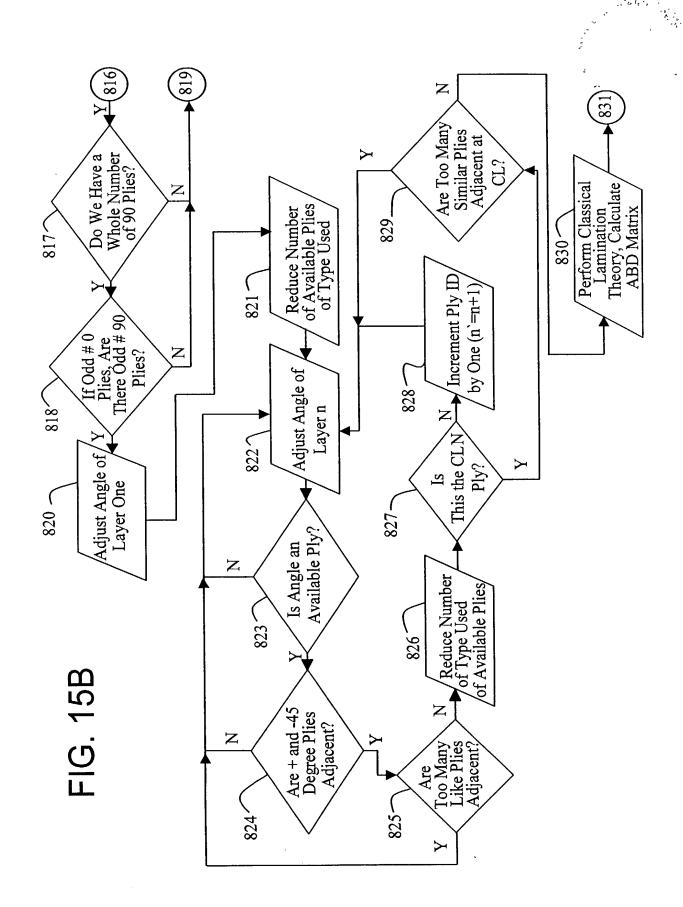


## FIG. 15A

801

User Inputs: Name of saved output file, Laminate thickness, Maximum allowed thickness, Ply thickness, Number of materials, Material properties (stiffness, poisson's ratio, thermal expansion coefficients, stress and strain allowables), Laminate family, Allowed variation in family, Extreme bounds on family, Number of similar adjacent plies allowed, Surface cloth material desired for moldline panels, Loading options, Failure criteria (Max. stress, max. strain, Tsai-Hill, Bearing-Bypass), Number of load cases, Load angle with respect to material axis, In-plane loads and moments, Pressure on panel, Panel Geometry, Data reduction flags (number of desired solutions based on strength or stiffness requirements -- for strength the most positive safety margin, the least positive safety margin and a defined number of intermediate solutions; for stiffness the most and least stiff and a defined number of intermediate solutions for each primary stiffness).





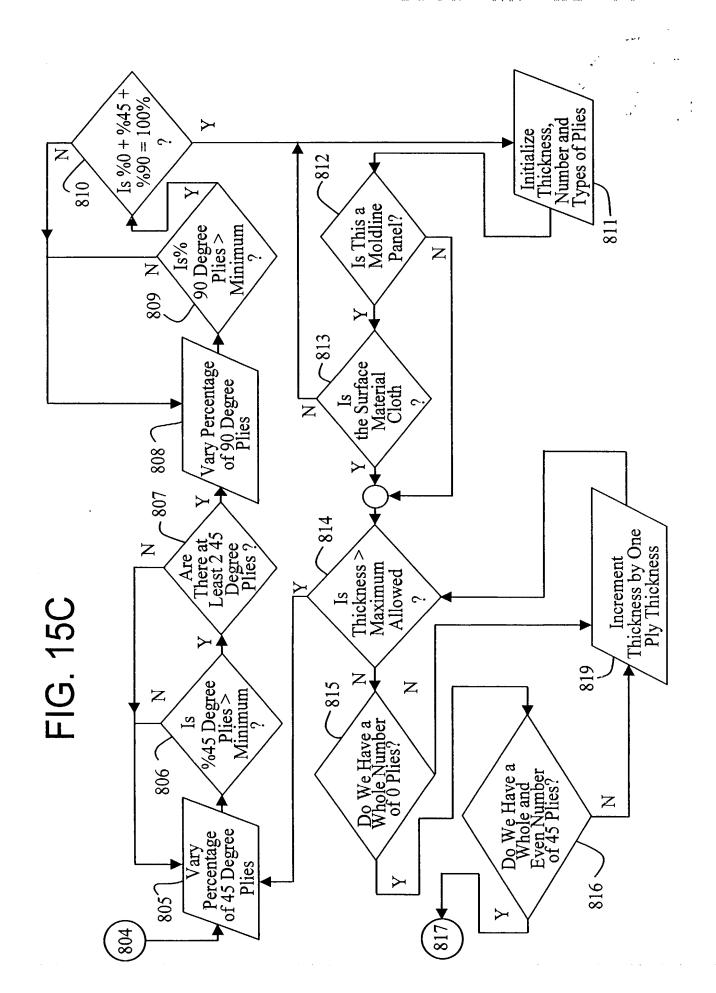
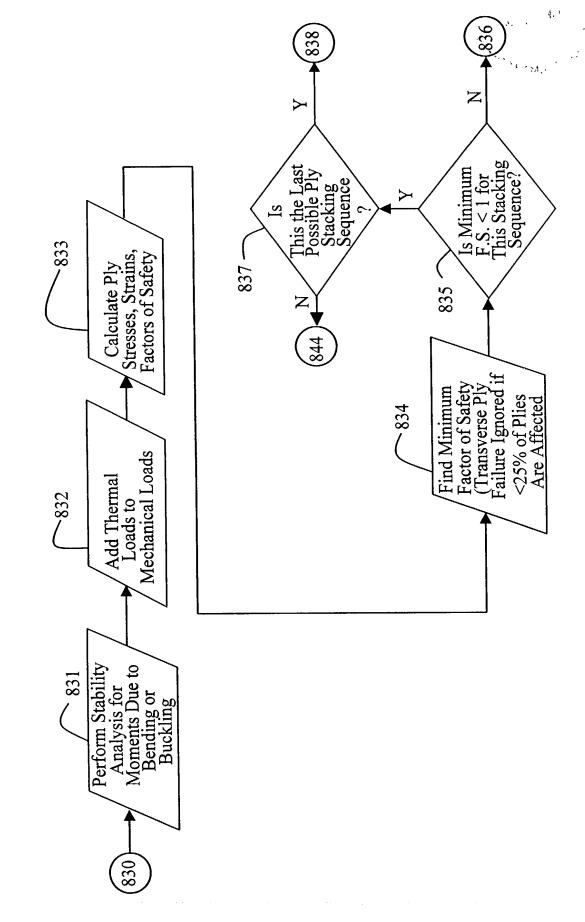


FIG. 15D



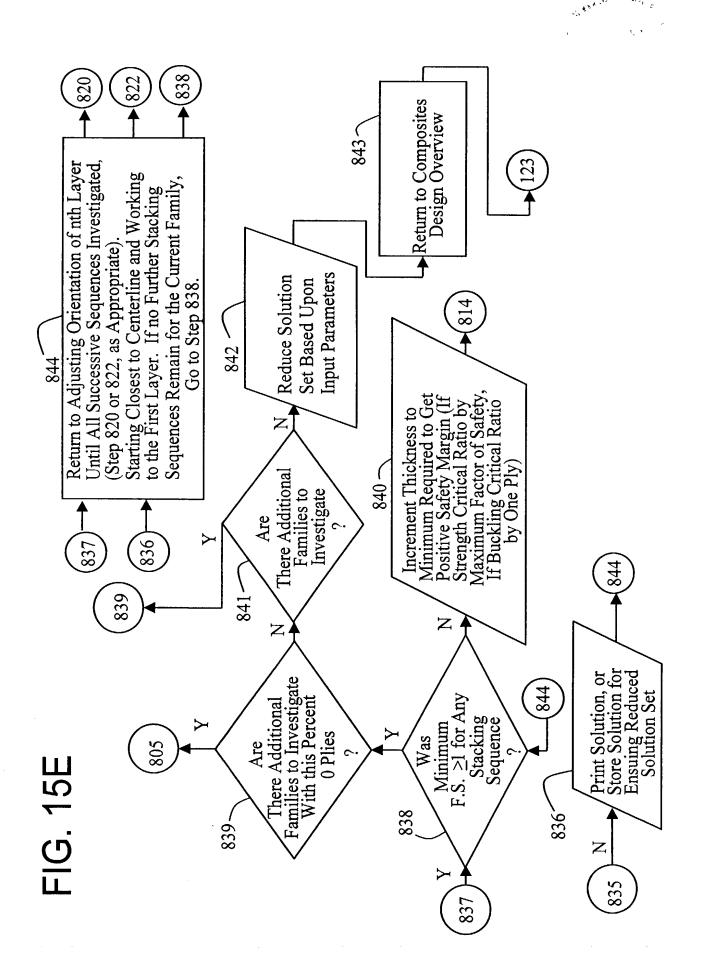
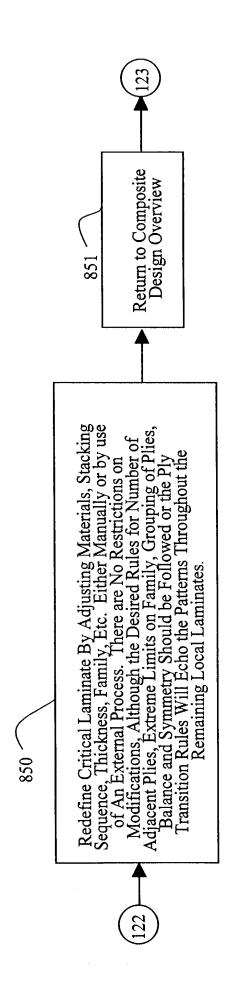
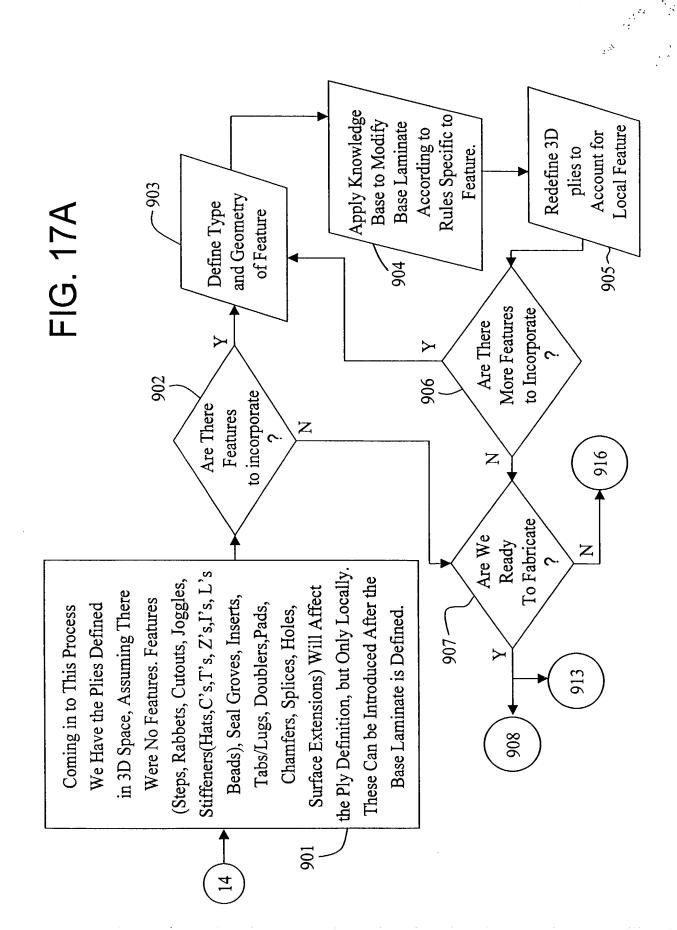


FIG. 16





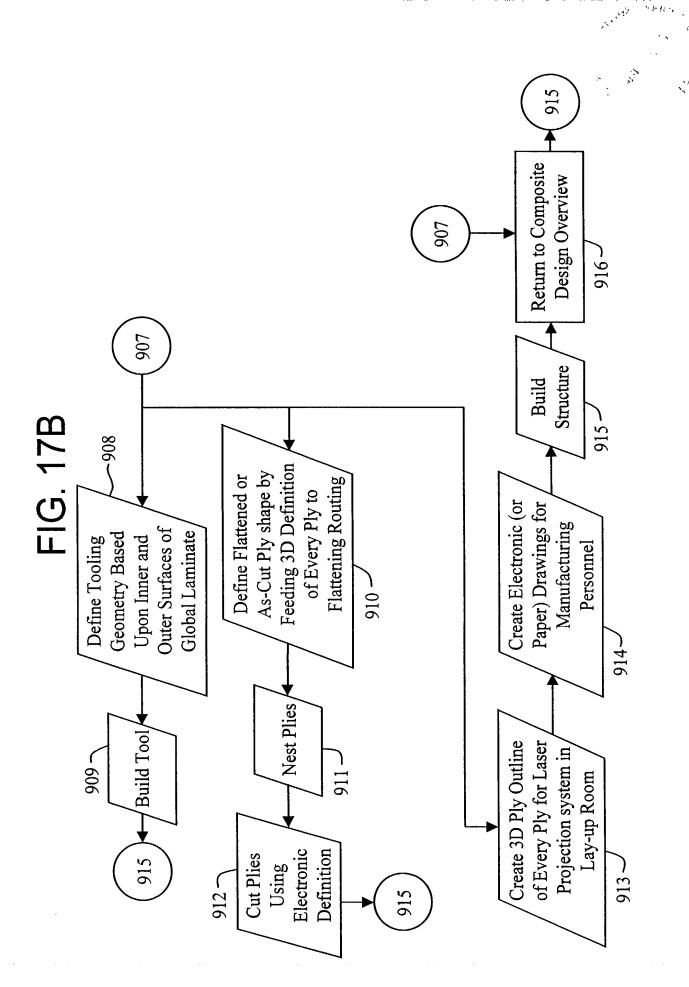
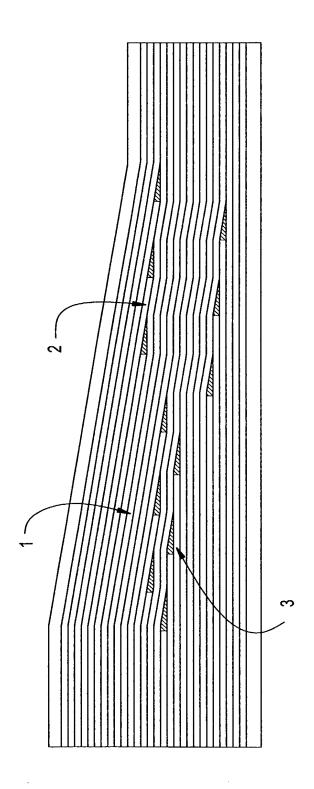


FIG. 18



24 plies 16 plies FIG. 19 20 plies 13 plies 18 plies

FIG. 20

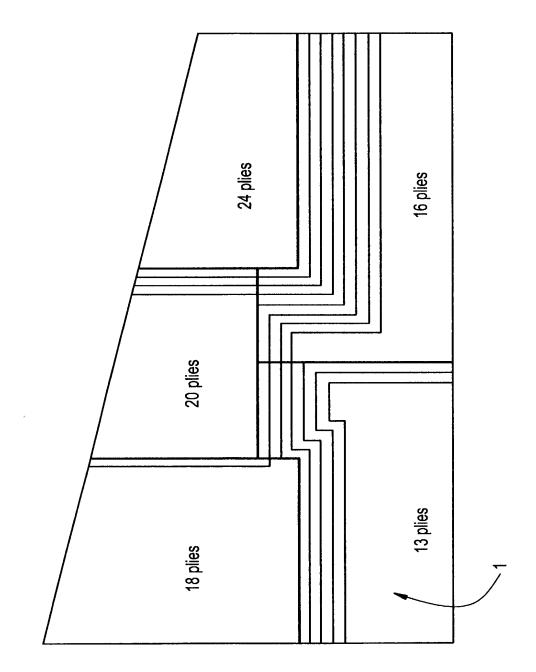
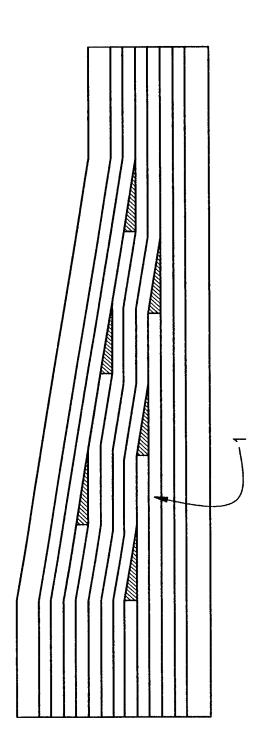


FIG. 21





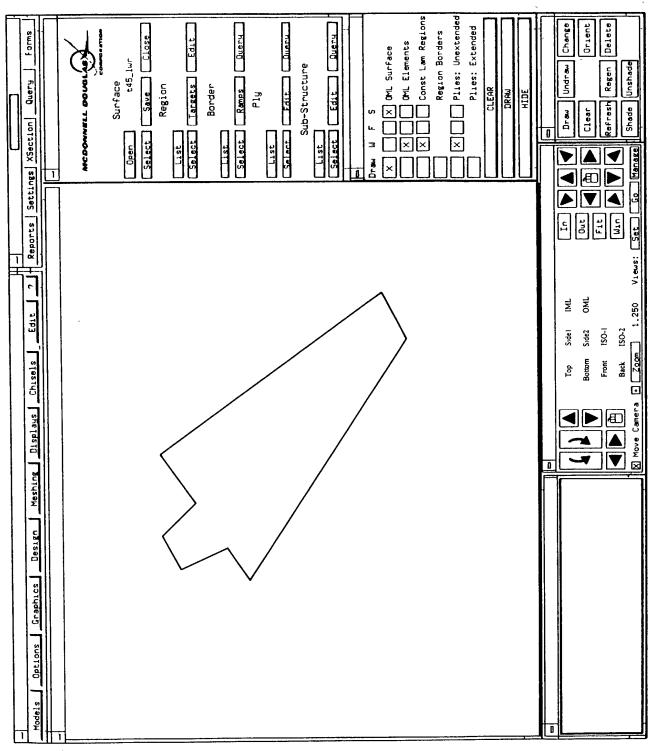


FIG. 22

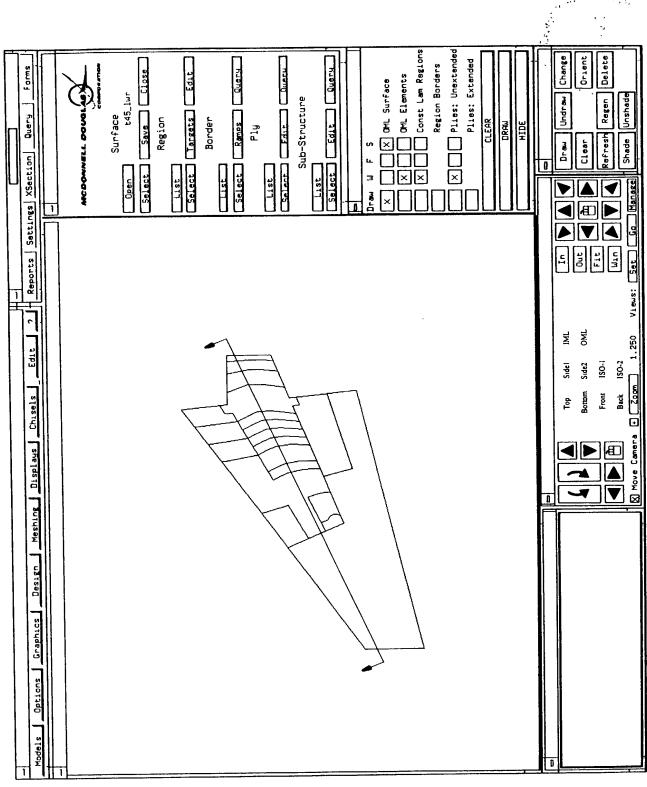


FIG. 23

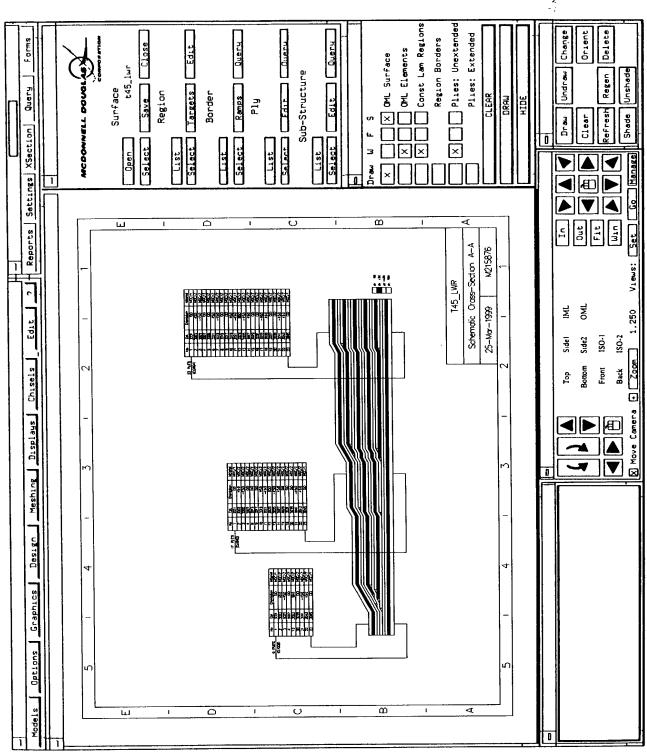
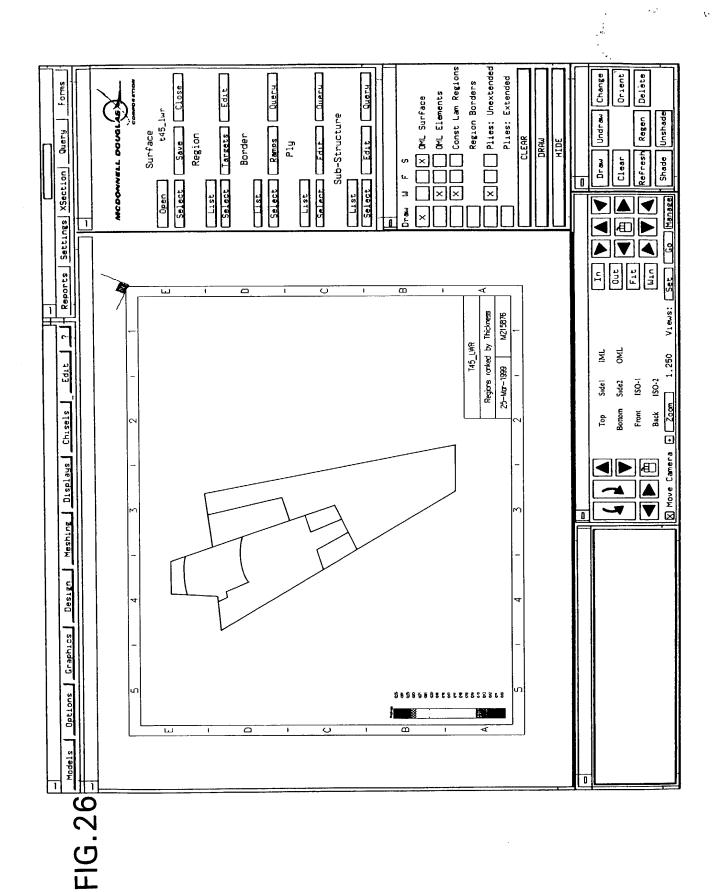


FIG. 24

Settings XSection Query Forms	Surface  Select Save Close  Region  List Select Targets Edit  Border  Salect Ramps Query  Ply  List Sub-Structure  Sub-Structure  Sub-Structure  The Select Edit Query  Select Edit Query  Region Borders  Region Borders  Region Borders  Region Borders  Ply  Plus: Extended	DRRW HIDE	Draw Undraw Change  Clear Orient  Refresh Regen Delete  Manees Shade Unshade
Models   Options   Graphics   Design   Meshing   Displays   Chisels   Edit   7   Reports   Sett	Region Information         Feature         Weight # Plies         Thickness         Family           Region Information         6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 -	All Save File CLOSE	Double Side IML In Dut Borrom Side OML Fit Front ISO-1 Wan Back ISO-2 War Gard Wan Brek ISO-2 War Gard Control of the Brek ISO-3 War Gard Control of the Bre

FIG. 25



Settings XSection Query Forms	Surface  Den t45_lwr  Select Save Close  Region  List  Select Targets Edit  Border  Ply  List  Sub-Structure  Salect Edit Query  Draw W F S  X	CLEAR DRAW HIDE	Draw Undraw Change Draw Undraw Change Clear Orient Refresh Regen Delete Manage Shade Unshade
Reports Sett	Volume Weight 36.44 2.15 27.07 1.60 27.07 1.60 27.07 1.60 27.04 0.43 7.34 0.43 7.34 0.43 7.39 0.28 1.92 0.01	asono Andrews	In
Chisels   Edit	Area Perimeter V 2602.80 251.99 2602.80 251.99 2602.80 251.99 2602.80 251.99 2602.80 251.99 2602.80 129.77 676.97 129.77 484.77 25.199 184.27 62.91		Top Sidel IML  Bottom Side2 OML  Front 150-1  Back 150-2
Ske ldsi0	Max 64.42 64.42 64.42 64.48 64	e F11e	
Design   Meshing	Lower Skin 64.42 86.48 86.48 86.48 86.48 86.19 6.108 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1316 6.1318 5.2013 6.1318 5.2013 6.1014 6.101	A B C	
Options   Graphics	REIDN ata Table:  Part Name:  Part Length:  Max Part Length:  Max Part Length:  Part Parimeter:  axmmm Thickness:  Inname Thickness:  Inname Thickness:  Material Volume:  Engre, Ply Count:  U Data for Material  U Data for Material  Material Wolw  Total Ply Perimetry  And Ply Per	Print	
Model s	NEW VERSION Part Data T.  Max Maxmu Minnum Minnum Minnum Morenge Mater Summary Dat Total Entra Total Max	▼	0

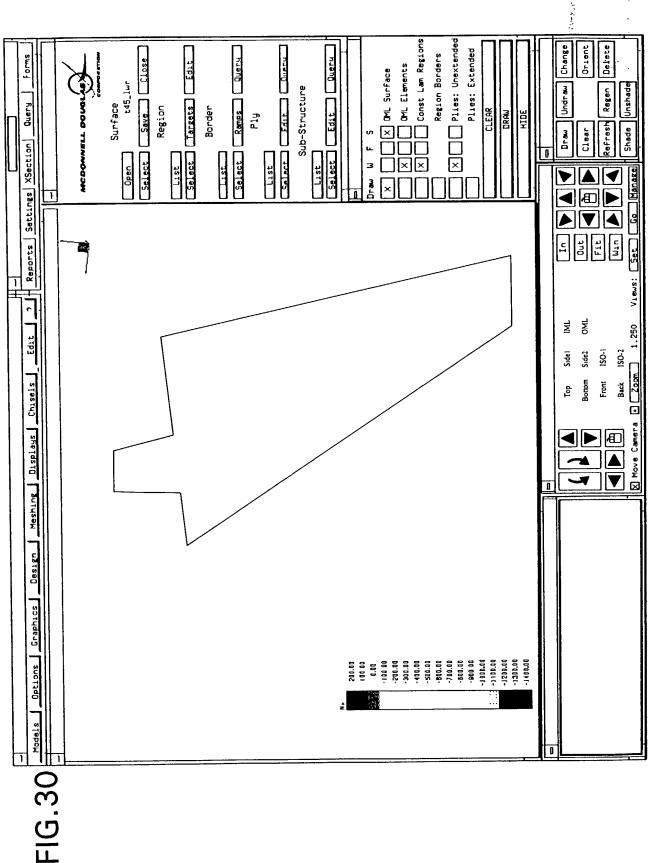
FIG. 27

	Con Query Forms	NETT DOORTES	COMPONETION	Rule □ × 19 Edıt	15 Edit	Se M	-1	e 4 00	e 70 00	2	Previous Laminates	View	Vısualize	Tabular	Done	DRAW HIDE	Draw Change	Clear Refresh Regen Delete Shade Unshade
	1ill   1	MCDOWNELL			Thin Rgn	External	Centr	e L T	Percentag	. Ad	2	Compute	Implement		ab Lam	CLOSE		P C C C C C C C C C C C C C C C C C C C
Mesh   Graphics   Design   Mesh   Mesh	Displays   Chisels   Edit	Plies Family New Original		23 39 4/50 6/9 9 39 4/50 6/9 9 23 32 4/52 9/14 7 39 4/50 6/9 9 21 33 9/55 3/10 8 33 9/55 3/10 6 21 8/5 3/10 8 33 9/55 3/10 8 34/50 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8 34/55 3/10 8	21 47 5/40 6/11 9 33 9/55 3/10 21 39 3/42 8/17 9 33.9/55 3/10	17 41 5/45 2/13.3 41.5/45 2/13 17 32 0/47 9/20 0 41 5/45 2/13 17 32 0/47 9/20 0 41 5/45 2/13	15 34 1/51 0/15.0 34.1/51 0/15 15 34 1/51 0/15.0 34 1/51 0/15 15 32 0/5/ 1/51 0/15.0 34 1/51 0/15	15 52 7/29 2/17 34 1/51 0/15 15 57 7/29 2/17 34 1/51 0/15 15 42 1/31 5/26 4 34 1/51 0/15 11 45 7/34 2/20 1 45 7/34 2/20	11 45 7/34.2/20 1 45 7/34 2/20 11 45 7/34 2/20 11 45 7/34.2/20 1 45 7/34 2/20	11 51 5/5/ 4/51 5 45 7/5# 2/20 9 34 5/41.3/24.2 34.5/41 3/24							 Top Side	Bottom Side2 OML Front 150-1 Back 150-2
	cs   Design	Weight # of		16 0 27 0 27 59 0 55 0 58 14 0 88 0 88	54 0 50 0 55 54 0 47 0 54	74 0 43 0 43 33 0 40 0 42	33 0 72 0 72 55 0 58 0 58	29 0 47 0.54 20 2 42 3 00 1 56 1 56	32 0 33 0 33 46 0 57 0 57	17 46 U 11 U 13 1215 90 7 23 7 23	18 20 25 21							

FIG. 28

;; X OML Surface
OML Elements
Const Lam Regions Plies: Unextended Change Orient Ramps Query Region Borders Edit Select | Edit | Duer Surface t45\_1wr Unshade Sub-Structure Plies: Save Targets Region Border Refresh Clear Shade XSection Select  $\times$ 3 Settings Win Out Reports 19 34.5/41 3/24.2 18 45.7/34.2/20.1 ¥ OMIL OMIL 17 457/342/201 150-2 Side2 150-1 16 45 7/34 2/20.1 Sidel 15 45.7/34.2/201 Chisels Front Back 14 34.1/51.0/15.0 13 34 1/51 0/15.0 • 12 34 1/51/0/15/0 11 34.1/51.0/150 Displays 10 34.1/51.0/15.0 9 41.5/45.2/133 V 8 41.5/45.2/13.3 Meshing 7 41,5/45.2/13.3 6 33.9/55.3/10.8 5 33.9/553/10.8 4 33.9/55.3/108 Design 339/553/108 2 39.4/50.6/9.9 394/50.6/9.9 Options

FIG. 29



			\$
gs XSection Query Forms	MCDOWNELL DOUGLAS	Surface  Surface  Select Save Close  Region  List  Salect Ramps Queru  Ply  List  Sub-Structure  List  Sub-Structure  Sub-Structure  Thy  Sub-Structure  Sub-Structure  Thy  Sub-Structure  Sub-Structure  Thy  Sub-Structure  Sub-Structure  Thy  Sub-Structure  Sub-Structure  The Megion Borders  Region Borders  HIDE	The Undraw Change Clear Orient Change Change Clear Orient Clear Care Care Care Care Care Care Care C
Edit 2 Reports Settings			IML In Out Out Out Fit Hit Min I.250 Views: Set
			Company   Comp
Graphics Design Meshing		1 pies	
Models   Options   Gra		Regon 17, 21 ph 3001 1 00 3003 2 49 3005 2 -45 3009 2 00 3013 2 -45 3015 2 0 3015 2 0 30	0

FIG. 31

F orms	16]	Delete  OK  UIT  CCTIONAL  IY	Gancel (S. 1)
Reports Sattings XSection Query F	3.000 66.7/0.0/33.3 [1] 0.000 0.0/0.0/0.0 [1] 0.153 22.8/54.5/22.8 [12] 0.163 34.1/51.0/15.0 [3.11] 0.236 32.4/52.9/14.7 [18] 0.132 42.1/31.5/26.4 [1] 0.142 53.7/29.2/17.1 [2] 0.122 45.7/34.2/20.1 [5.13.16] 0.111 31.3/7.4/31.3 [14] 0.101 34.5/41.3/24.2 [15] 0.000 0.0/0.0/0.0 [1] Reg	Import	Xt   1 0000E+0;   t   1 0000 
Chisels Ledit 7	default 3 3 4 fem-mat-1 0 0 fem-mat-10 14 0 fem-mat-11 15 0 fem-mat-12 22 0 fem-mat-14 13 0 fem-mat-15 11 0 fem-mat-17 9 0 fem-mat-2 0 0 current	Material Catalog  default DEFAULT DEFAULT DEFAULT DEFAULT DEFAULT DEFAULT EDC/38 EDC/3	Ex [1] Ey [1] Es [1] Nux [1] Nux [1] New [1,050]
s Options Graphics Design Meshing Displays			Move Camera

Change Orient 50.0/40.0/10.0 Variation in 0/+45/90 5.0/ 5.0/ 5.0 View 0.1248 0.1248 MDC/1 7.0 Unshade Regen Adjacent Plies Allowed Refresh # Strength Solutions: Material at Surface: # Solutions Targets: # Stiffness Targets: Clear # Within Laminate: Maximum Bound: Thickness Bound: Minimum Bound: Load Conditions: Compute Failure Criteria: Reports Settings XSection #.At.Centerline; Target Family: Apply Loads: Thickness: Material: Region: Out 뒬 Side2 150-1 Front Chisels Back Meshing Displays Design

FIG. 33

ings XSection Query Forms	WCDOWNETT BORBY TO	Surface  Open t45_lwr  Select Save Close  Region	Select Targets Edit  Border	Select Ramps Queru Ply	<u> </u>	Draw W F S	CLEAR DRAW HIDE	Draw Undraw Change	Regen
									ISO-

FIG.34

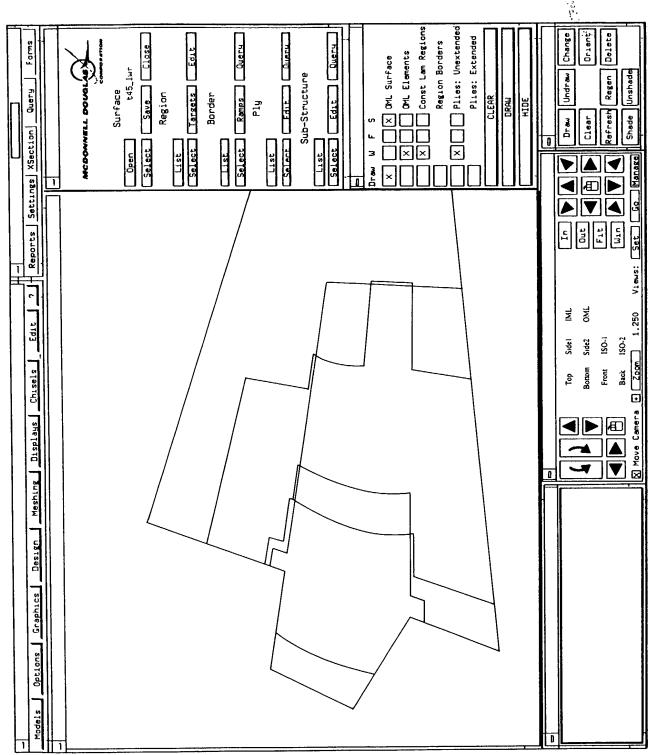


FIG. 35

